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(54) MANUFACTURE OF SEMICONDUCTOR DEVICE AND APPARATUS FOR MANUFACTURE THE SAME, TESTING OF THE SAME AND TESTING APPARATUS

(57)Abstract:

PURPOSE: To provide a method for manufacturing a product such as a semiconductor device with high reliability and efficiency and an apparatus for manufacturing the same and also provide a method for testing the same and apparatus for testing the same.
CONSTITUTION: An automatic testing unit 1 for extracting a fault based on the preset test standard of a sample to be tested and a unit 2 for receiving an information about a fault extracted and obtained by the testing unit 1, classifying and outputting a kind of fault based on similarity of fault and extracting characteristic value about the fault based on the classified result are comprised. Moreover, unit 4 is also comprised to adjust the manufacturing apparatus by converting the characteristic value into a parameter for controlling the state of apparatus for manufacturing the product to be tested and feeding back the converted parameter to the manufacturing apparatus of the product to be tested.
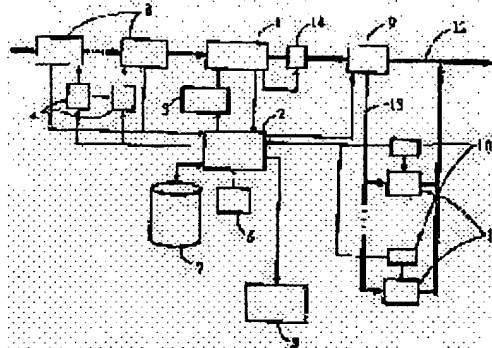
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention -- a manufacture -- dependability -- it is related with the inspection approach and its equipment at the manufacture approaches, such as a semiconductor device for manufacturing highly and efficiently, and the equipment list of those.
[0002]
[Description of the Prior Art] Conventionally, the following approaches were taken in the system which controls the manufacture process based on the automatic check of an inspected object, correction, and an automatic check result. That is, the worker judged based on overlooking discovered at the numerousness or back process of the misreport which puts an excellent article in order as a defect about the dependability of the judgment result in the process which inspects an inspected object by the automatic check, when there were many incorrect judgings, the parameter about the defective criterion of an automatic test equipment was changed suitably, and it corresponded, and the automatic test equipment was employed. As a result of inspection by this automatic test equipment, the inspected object judged that is normal was poured by degree process, and after it corrected by being sent to a correction process about the object which the inspected object judged that is poor can correct, it was sent to degree process. Moreover, as a result of checking two or more inspected objects automatically, the worker has grasped the manufacture condition of an inspected object statistically, the parameter for controlling the condition of the manufacture machine of an inspected object was changed if needed, and the condition of the manufacture process of an inspected object was adjusted.
[0003] As an above-mentioned example, the operator had classified defective classes, such as a foreign matter and a poor pattern, or a misreport according to the semiconductor wafer production process by viewing using the microscope which equipped test equipment with the defective candidate who detected, or the microscope of another stage using the test equipment which pinpoints defective candidate locations, such as visual-inspection equipment (JP,61-151410,A, JP,62-43505,A) and foreign matter test equipment (JP,54-101390,A). Moreover, the approach using a superimposed focal spot image as a classification means of the detected defect is indicated by JP,2-170279,A. The recently and Israel Galai lab and the U.S. ADE company are an automatic-classification technique (M. Luria, E.Adin, M.Moran, D.Yaffe& J.Kawski:Automatic Defect Classification Using Fuzzy Logic, ASMC'93 Bosston MA, 1993) together. Although announced, it is unknown for details. It is analyzed by the worker, and the result of having classified the defect specifies the manufacturing installation considered to be the defective generating cause, also taking into consideration the inspection result in other processes. The production process staff who became skillful to the specified equipment was performing adjustment, a maintenance, etc. of a manufacturing installation control condition parameter based on experience.
[0004] The test equipment of a short defect like JP,4-72552,A detected the short defect, and the defect was classified into a foreign matter, the aluminum remainder, a through hole, etc. according to the thin film transistor substrate production process for liquid crystal displays by visual inspection.
[0005]

[Problem(s) to be Solved by the Invention] Although the above-mentioned conventional example is considered about automation of inspection, or automation of inspection correction in the system which controls the manufacture process based on the automatic check of an inspected object, correction, and an automatic check result, it has the following troubles. The automatic test equipment consists of information processing systems which analyze the existence of the defect of an inspected object, the class of defect, etc. based on the information acquired from the detection system aiming at actualizing the defect set as the object of an inspected object, and its detection system. For this reason, when are in the tolerance where a manufacture process is judged to be normal, it changes, the condition of an inspected object changes as that result and it is judged with those with defective by the inspected object by the automatic test equipment, an operator has the need of adjusting so that an automatic test equipment may operate proper. As mentioned above, since the detection system and information processing system of an automatic test equipment are the thing of an equipment proper, difficulty follows them on changing this substantially. For this reason, an operator will perform the above-mentioned adjustment by changing the parameter which controls information processing systems, such as sensibility of a detection system. And this activity used the automatic test equipment, in order to double it with the time limits/maintenance check currently employed in the manufacture site, it was given to the trial-and-error target in many cases, and it has caused long duration-ization of time amount until an automatic test equipment functions normally. Moreover, when the automatic test equipment was installed in in-line one, it had the technical problem that the flow of manufacture will be stopped as a result.

[0006] Moreover, although there are some which output only the information about the location of the defect of an inspected lifter when there are existence of a defect and a defect in an inspected object as one gestalt of an automatic test equipment, in such an automatic test equipment, a worker will classify a defect and it can be checked whether the above-mentioned parameter of an automatic test equipment is appropriately set up for the first time as a result of classification analysis. In this case, while it does not remain because time amount until an automatic test equipment functions normally long-duration-izes, but the worker is doing the classification analysis activity of a defect, the inspected object inspected by the automatic test equipment has the danger of passing an inspection process by the mistaken time limits/maintenance check.

[0007] When automatic check correction which was mentioned as the conventional example was made in the state of adjustment with an automatic test equipment inadequate as mentioned above, it had the technical problem that the mistaken correction was performed to an inspected object.

[0008] Moreover, a worker judges and does corrective action control of whether it was right, activation and the nonfulfilment, i.e., the classification-of-defect result, of correction, or it had mistaken, and a means to feed back a worker's confirmed information to the classification-of-defect result by the automatic test equipment to an automatic test equipment is not considered at all.

[0009] When using the defective decision output of the automatic test equipment of a condition with the above adjustments insufficient as an adjustment means of the manufacture machine of an inspected object similarly, the parameter which controls the manufacture condition of the suitable inspected object of the manufacture machine of a suitable inspected object cannot be adjusted. Moreover, the technical problem that time amount is taken to complete adjustment of a manufacture machine in order that a worker may apply feedback to a manufacture machine based on the inspection result which an automatic test equipment outputs also occurs.

[0010] Moreover, if an inspected object inspects using the automatic test equipment which adjustment mentioned as the conventional example in the inadequate condition but as mentioned above required [the information about defective generating of an exact inspected object and the information on the condition of the manufacture process at that time] for the stability of a manufacture process, in order to perform adjustment of exact defective generating and a manufacture process in parallel, it had the technical problem take time amount to examine the correlation of defective generating and a manufacture process condition.

[0011] It had the technical problem that the causal relation of the defect detected in that the defect

originates in which production process or a culmination and the defect detected by the midcourse phase was not known, either, even if a defect is detected by the inspected object when it is the inspection or the final inspection after degree process since the viewpoint of giving an inspected object has escaped from the information which serves as an inspection result of an inspected object, and its basis by the conventional automatic test equipment at the last.

[0012] The purpose of this invention is to offer a means adjust to the condition of a manufacture process also as that of coordination with a worker promptly the optimal suitably in view of the time limits/maintenance check of an automatic test equipment that the technical problem of the above-mentioned conventional technique should be solved, and provide with the inspection approach and its equipment the manufacture approaches, such as a semiconductor device which enabled it to attain stabilization of a manufacture process, and automation of an inspection correction process as the result, and the equipment list of those.

[0013]
[Means for Solving the Problem] The above-mentioned purpose (A),

The automatic check unit 1 which extracts a defect based on the time limits/maintenance check of the inspected object set up beforehand, The unit 2 which is based on the similarity of reception and said defect in the information about the defect according to which it may be extracted in said inspection unit 1, classifies and outputs the class of defect, and extracts the characteristic quantity about said defect based on said classified result, Said characteristic quantity is changed into the time limits/maintenance check of the inspection unit 1, and it constitutes from a unit 3 which feeds back the time limits/maintenance check after conversion to the automatic check unit 1, and adjusts the automatic check unit 1.

[0014] (B)
The automatic check unit 1 which extracts a defect based on the time limits/maintenance check of the inspected object set up beforehand, The unit 2 which is based on the similarity of reception and said defect in the information about the defect according to which it may be extracted in said inspection unit 1, classifies and outputs the class of defect, and extracts the characteristic quantity about said defect based on said classified result, Said characteristic quantity is changed into the parameter which controls the condition of the manufacture machine of an inspected object, and it constitutes from a unit 4 which feeds back the parameter after conversion to the manufacture machine of an inspected object, and adjusts said manufacture machine. When the classification result of the defect performed to (C), (A), or (B) by the unit 2 in the unit 2 of a publication is different, a means by which a right classification-of-defect result can be taught is provided.

[0015] (D)
(A) Or provide the means which makes it possible to show an operator visually the result that it was similar to (B) by the defect in the unit 2 of a publication, and for an operator to be able to check each information on a classification-of-defect result and the information relevant to it, and to add new information for said information to modification or said information.

[0016] (E)
A means to accumulate the information on a publication and the information on the defective part of the inspected object corresponding to it in (D) for every defect is provided.

[0017] (F)
It has the function to extract the characteristic quantity about a defect from information given in two or more (D) accumulated in the information storage means indicated by (E), and the information on the defective part of the inspected object corresponding to it, and the time limits/maintenance check in delivery and the inspection unit 1 indicated by (A) by this is corrected to the unit 3 given [said characteristic quantity] in (A).

[0018] (G)
From information given in two or more (D) accumulated in the information storage means indicated by (E), and the information on the defective part of the inspected object corresponding to it, it has the function to extract the characteristic quantity about a defect, and adjustment of delivery and the

manufacture machine indicated by (B) by this is performed to the unit 4 given [said characteristic quantity] in (B).

[0019] (H)
The function to add the information on a manufacture process when this defect occurs, to match the hysteresis information on the generating situation of a process condition and a defect, to hold to information given in (D) accumulated in the information storage means indicated by (E) and the information on the defective part of the inspected object corresponding to it, and to show them is provided.

[0020] (I)
(A) or the time when the unit 2 given in (B) cannot classify the classification result of the defect of an inspected object into the existing category -- this -- a defective class -- the class which it presupposed that it is unknown, and the information and related information of said defective part were shown to the operator, and was shown the operator -- provide a means by which the new or existing classification, a name, etc. can be taught to an unknown defect.

[0021] (J)
The information on a defective part given in (E), (F), (G), (H), and (I) is image information which consists of a detection defect and its near.

[0022] (K)
(A) Or make predetermined correction for the inspected object inspected by (A) in the automatic check unit 1 of a publication according to the result that it was similar to (B) by the defect in the unit 2 of a publication on a defective correction unit to a sink and said defect.

[0023] (L)
In a defective correction unit given in (K), the function which an operator can control activation of a corrective action, can teach a right classification-of-defect result in said defective correction unit when the classification result of the defect directed to (A) or (B) by the unit 2 of a publication is different, and can feed back the information to said unit 2 is provided.

[0024] (M)
(A) And use the pattern information on a defective detection image for (B) as similarity of the defect of a publication.

[0025] (N)
(A) And use the signaling information of defective detection information for (B) as similarity of the defect of a publication.

[0026] (O)
** which gives the information relevant to both inspected both [an inspection result, a measurement result, each either, or] to an inspected object.

[0027] (P)
The manufacture machine presumed to be the defective generating cause in view of the classification result of a defect and the attribute of the defect in the unit 2 given in (B) is chosen, and the characteristic quantity about the defect extracted by the unit 4 given in (B) connected to said manufacture machine in the unit 2 of a publication at (B) is transmitted.

[0028] It is attained especially more.

[0029] In addition, although the automatic test equipment described above means independent test equipment of course, it is a unit possessing the monitoring device which supervises the condition of an inspected object, inspection, or the function of a monitor, and may be contained in some manufacture machines.

[0030]
[Function] The above-mentioned means functions how and it explains below whether the purpose of this invention is attained using drawing 1 . The thick wire shown by 12 expresses the flow in the manufacture process of an inspected object. 1 is an automatic test equipment and possesses the function to extract a defect based on the time limits/maintenance check of the inspected object set up beforehand. 2 is classification-of-defect equipment which extracts the classification of a defect, and its characteristic

quantity. An automatic test equipment 1 sends the information about the defect according to which it may be detected to classification-of-defect equipment 2 as a result of inspection. The information about a defect points out the information used as the foundation for judging it as the electrical signal and defect which are acquired as a result of detecting the image of a defective part, and a defective part etc. Classification-of-defect equipment 2 classifies a defect based on this information. Based on various characteristic quantity, although automatically carried out in MODERUBE-SU, this classification is equipped with a rule base means 6 to teach a classification result, in order to correct this classification result. It is the unit which has the means which enables 6 to show an operator visually the result that it was similar by the defect again, and for an operator to be able to check each information on a classification-of-defect result and the information relevant to it, and to add modification or new information for the information. Classification-of-defect equipment 2 updates the interpretation of the characteristic quantity of a defect [/ based on the classification result taught by the unit 6].

[0031] 3 is a unit possessing the function to change into the time limits/maintenance check of 1 the characteristic quantity of the defect classified according to classification-of-defect equipment 2, and transmits the reference value after changing into an automatic test equipment 1. When the classification result and the judgment result of 1 which were judged by classification-of-defect equipment 2 differ from each other, it lets a unit 3 pass, and the classification-of-defect result by classification-of-defect equipment 2 is made to reflect in an automatic test equipment 1.

[0032] 8 is the manufacture machine of an inspected object, and 4 is a unit possessing the function to change into the control parameter about the manufacture conditions of the inspected object of the manufacture machine 8 the characteristic quantity of the defect classified according to classification-of-defect equipment 2, and transmits the control parameter after changing into the manufacture machine 8 of an inspected object. At this time, only a required number chooses the manufacture machine 8 which should be adjusted by the classification result of a defect, and classification-of-defect equipment 2 possesses the function to transmit information to the unit 4 connected to the selected manufacture machine 8.

[0033] The result classified according to the information and the classification-of-defect equipment 2 which 7 is the are recording means of the information connected to classification-of-defect equipment 2, and are sent from an automatic test equipment 1 for every defect of a non-inspecting object, The information used at the time of a classification, different image information from what is obtained from the automatic test equipment 1 about the part of since the defective part, its near, or the defect of a non-inspecting object is characterized to classification-of-defect equipment 2, an and also [it is the need], Or if it has a means to acquire an electrical signal, those information will be recorded altogether alternatively. Moreover, the information which possessed and received the function to receive the information concerning [classification-of-defect equipment 2] the operating state of the manufacture machine 8 of an inspected object is added to the information about the aforementioned inspected object, and is recorded on the information storage means 7. Information for every defect recorded on the information storage means 7 is processed in statistics processing etc. if needed, and an operator is shown it in the unit 6 connected to classification-of-defect equipment 2. Moreover, the information for every defect recorded on the information storage means 7 and the information acquired from classification-of-defect equipment 2 are alternatively sent to the production control system in which all are shown by 5.

[0034] Directions are sent to the inspected object sorting unit 9 from classification-of-defect equipment 2 so that the inspected object which has the defect which 9 is the sorting unit of an inspected object and was judged as correction being required with classification-of-defect equipment may flow to correction Rhine shown by 13 and an inspected object may go to the correction unit 11 corresponding to the classified defect. The correction unit 11 may be one unit which can correct all defects, or its multi-unit ************* is also good corresponding to the class of defect. Although the corrective action is premised on automatic correction, an operator can check whether it corrects or not, and when the defective class in a correction part differs from the class which classification-of-defect equipment 2 judged, it has composition fed back to classification-of-defect equipment 2 in the thing in which the classification result had made a mistake through the unit 10.

[0035] 14 is a unit which has the function which gives the information which accompanies the inspection result of an automatic test equipment 1, and it to an inspected object.

[0036] The above system configuration enables it to manufacture an inspected object to high reliance efficiently.

[0037]

[Example] Hereafter, the example of this invention is explained. First, the place which this invention means is notionally explained using drawing 1 .

[0038] The thick wire shown by 12 expresses the flow in the manufacture process of an inspected object. 1 is an automatic test equipment and possesses the function to extract a defect based on the time limits/maintenance check of the inspected object set up beforehand. It is classification-of-defect equipment which extracts the classification of ******, and its characteristic quantity. An automatic test equipment 1 sends the information about the defect according to which it may be detected to classification-of-defect equipment 2 as a result of inspection. The information about a defect points out the information used as the foundation for judging it as the electrical signal and defect which are acquired as a result of detecting the image of a defective part, and a defective part etc. Classification-of-defect equipment 2 classifies a defect based on this information. Based on various characteristic quantity, although automatically carried out in MODERUBE-SU, this classification is equipped with a rule base means 6 to teach a classification result, in order to correct this classification result. It is the unit which has the means which enables 6 to show an operator visually the result that it was similar by the defect again, and for an operator to be able to check each information on a classification-of-defect result and the information relevant to it, and to add modification or new information for the information. Classification-of-defect equipment 2 updates the interpretation of the characteristic quantity of a defect [/ based on the classification result taught by the unit 6].

[0039] 3 is a unit possessing the function to change into the time limits/maintenance check of 1 the characteristic quantity of the defect classified according to classification-of-defect equipment 2, and transmits the reference value after changing into an automatic test equipment 1. When the classification result and the judgment result of 1 which were judged by classification-of-defect equipment 2 differ from each other, it lets a unit 3 pass, and the classification-of-defect result by classification-of-defect equipment 2 is made to reflect in an automatic test equipment 1.

[0040] 8 is the manufacture machine of an inspected object, and 4 is a unit possessing the function to change into the control parameter about the manufacture conditions of the inspected object of the manufacture machine 8 the characteristic quantity of the defect classified according to classification-of-defect equipment 2, and transmits the control parameter after changing into the manufacture machine 8 of an inspected object. At this time, only a required number chooses the manufacture machine 8 which should be adjusted by the classification result of a defect, and classification-of-defect equipment 2 possesses the function to transmit information to the unit 4 connected to the selected manufacture machine 8.

[0041] The result classified according to the information and the classification-of-defect equipment 2 which 7 is the are recording means of the information connected to classification-of-defect equipment 2, and are sent from an automatic test equipment 1 for every defect of a non-inspecting object, The information used at the time of a classification, different image information from what is obtained from the automatic test equipment 1 about the part of since the defective part, its near, or the defect of a non-inspecting object is characterized to classification-of-defect equipment 2, an and also [it is the need], Or if it has a means to acquire an electrical signal, those information will be recorded altogether alternatively. Moreover, the information which possessed and received the function to receive the information concerning [classification-of-defect equipment 2] the operating state of the manufacture machine 8 of an inspected object is added to the information about the aforementioned inspected object, and is recorded on the information storage means 7. Information for every defect recorded on the information storage means 7 is processed in statistics processing etc. if needed, and an operator is shown it in the unit 6 connected to classification-of-defect equipment 2. Moreover, the information for every defect recorded on the information storage means 7 and the information acquired from classification-of-

defect equipment 2 are alternatively sent to the production control system in which all are shown by 15.

[0042] Directions are sent to the inspected object sorting unit 9 from classification-of-defect equipment 2 so that the inspected object which has the defect which 9 is the sorting unit of an inspected object and was judged as correction being required with classification-of-defect equipment may flow to correction Rhine shown by 13 and an inspected object may go to the correction unit 11 corresponding to the classified defect. The correction unit 11 may be one unit which can correct all defects, or its multi-unit ************* is also good corresponding to the class of defect. Although the corrective action is premised on automatic correction, an operator can check whether it corrects or not, and when the defective class in a correction part differs from the class which classification-of-defect equipment 2 judged, it has composition fed back to classification-of-defect equipment 2 in the thing in which the classification result had made a mistake through the unit 10.

[0043] 14 is a unit which has the function which gives the information which accompanies the inspection result of an automatic test equipment 1, and it to an inspected object.

[0044] The example applied to the semiconductor wafer production process as 1st concrete example is shown in drawing 2 . The outline of a wafer production process repeats membrane formation by membrane formation equipment 321, the pattern exposure by the aligner 322, a developer 323, and an etching system 324 many times, on the wafer, is formed and carries out the laminating of the pattern. The inspection unit 320 is inserted in the middle of the wafer production process performed repeatedly, a defective candidate's location is pinpointed for the purpose of quality control by total or sampling, and the positional information, detection image information, defective distribution information, a wafer to be examined, etc. are sent to a classification of defect and the characteristic quantity extract unit 300. Classification-of-defect unit 300a performs collating with a defective model and a defective image database to each defective candidate, similarity is judged, a misreport is eliminated first, and then a defective class is classified. Unit 300b performs a defective generating cause judging from distribution of the classified information, the serial distribution information which classified and was accumulated in the past, and a defective location etc.

[0045] Next, the configuration of the classification of defect and the characteristic quantity extract unit 300 in drawing 2 is shown in drawing 3 . It is arranged on the network as the terminal 311 to show the inspection unit 320, defective generating cause judging unit 300b, and an operator information, issue directions, or for an operator input information where a classification of defect and the characteristic quantity extract unit 300 are the same, and image information, defective information, process information, etc. can communicate freely. A terminal 311 can be equipped with a bit mapped display, and can display image information. A character terminal and TV monitor may be substituted for a terminal 311. A classification of defect and the characteristic quantity extract unit 300 A control section 301, operation part 302, an image memory 303, and a stage The defective configuration for the lighting 346 to the device control section 304 and detector 347 to control, and a wafer 360, a half mirror 345, a lens 348, the X stage 340, the Y stage 341, the theta stage 342, Z stage 343, a means 350 to accumulate image data, and a classification, defective size, It consists of means 352 to memorize the classification model which modeled the texture of the color of a defect, a defect, and the physical relationship of a circuit pattern and a defect etc. However, these may use the thing of the inspection unit 320 as it is. Moreover, the network mentioned above will not be cared about if it connects electrically by the bus, serial communication like RS232C, and parallel communication link like Centronics.

[0046] The classification approach in a classification of defect and the characteristic quantity extract unit 300 is shown in drawing 4 . First, in the location of the defect detected by the inspection unit 320, an image 372 is picturized from a detector 347. Institute of Electronics, Information and Communication Engineers paper magazine D-II after considering location collating as the image 371 of the same pattern without the defect picturized in somewhere else on the same wafer as this Vol.J72-D-II No.12 The image 373 which took difference by having used the image of a normal part as the reference image, removed the wafer pattern, and extracted the foreign matter part by technique which is indicated by pp.2041-2050 is generated. The texture information 380 on a detection defective part, the distribution information 381 on a color or a shade, profile information, and a focus are changed from this image

information 373, characteristic quantity is extracted from the configuration information 382 which detects 3D information and is acquired, the area information 383, the positional information 384 on the wafer extracted from surrounding relative location information and the surrounding inspection unit 320 with a circuit pattern, etc., and a detection defect is mapped to the n-dimensional characteristic-quantity space which consists of several n of characteristic quantity.

[0047] The classification model which carries out a deer and is memorized by the storage means 352 specifies the field according to the characteristic quantity of each defect on this n-space, and after collating with this classification model the detection defect mapped by the above-mentioned n-dimensional characteristic quantity space and eliminating a misreport first, a defective class is classified next. A classification is clustered from the classifying space centering on characteristic quantity, as shown in drawing 5, and it identifies a defect. Although it expressed with two-dimensional since drawing 5 was easy, in fact, it is n dimensions as mentioned above, and the cluster of each defect is defined as a field with the breadth in this multi-dimension space as mentioned above.

[0048] In the part (slash section of a cluster) which overlapped by clustering in drawing 5, since it cannot identify as one kind of defect, each representation defect is shown to an operator like drawing 6, and an operator specifies a category. When not going into all the cluster, representation defective various kinds are put in order and shown to the near order of classifying space like drawing 7. The field of a cluster will be changed and updated if it can specify that it is one sort of the shown defect. If it is the newly discovered defect, a new cluster field will be registered. Moreover, even when classification identification is carried out, an operator can also change and update a cluster.

[0049] The information shown by 380, 381, 382, 383, and 384 which were detected here is newly memorized for the storage means 352 as data of a classification model. Moreover, the image data 371 and 372 at this time is newly added to the storage means 350, and an image database is built. Here, the defect which cannot be identified is shown to an operator using a terminal 311, and is newly registered into an image database also as registration and a classification model as a new defect. Moreover, the information shown by 380, 381, 382, 383, and 384 which were detected here is newly memorized for the storage means 352 as data of a classification model. Moreover, the image data at this time is also newly added to the storage means 350, and builds an image database. Here, the defect which cannot be identified is shown to an operator using a terminal 311, and is newly registered into an image database also as registration and a classification model as a new defect.

[0050] Although explanation was advanced on the assumption that a collating process was performed above in n-dimensional characteristic quantity space, you may carry out by taking correlation with the representation in each defective mode in a collated defective image and an image database, or two or more defective images using the image database built by the storage means 350.

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[0051] Moreover, in case an image is recorded on the storage means 350, the information on the parameter which controls, the condition, i.e., a wafer manufacturing installation which is mentioned later, of a manufacture process at that time, other test equipment, or a monitor is also made to add and memorize.

[0052] Since it can refer to by being reading, the above processing being reproducible later on at any time, and the condition of the manufacture process at that time also reading these image data from the storage means 350 as mentioned above, since the image data 371 and 372 of each defect is held by the above classification of defect and the feature-extraction processing at the storage means 350, and displaying on a terminal 311, it becomes possible to also grasp the condition of a defect and a manufacture process.

[0053] The characteristic quantity information used as a classification-of-defect result and its foundation is sent to defective generating cause judging unit 300b. The configuration of defective generating cause judging unit 300b is shown in drawing 8. Unit 300b is equipped with the cause model 363 which is model data for judging a cause from a control section 361, operation part 362, and a classification-of-defect result. These may use the control section 301 of the classification of defect and the characteristic quantity extract unit 300 of drawing 3, and operation part 302, and may connect the cause model 363 to this control section 301.

[0054] A cause judging identifies the cause of a defect as compared with the cause model 390 based on the characteristic quantity information used as the classification-of-defect result sent from a classification of defect and the characteristic quantity extract unit 300, and its foundation, as shown in drawing 9 . When unknown, an operator is shown using a terminal 311 and a cause model is registered newly. Here, as it is indicated in drawing 10 as the cause model 390, not only the classification result of each defect but distribution of the air cleanliness class information on the whole production line, time series defective information, and a defect etc. is used, the cause equipment of a defect is specified, and it transmits to the unit 331,332,333,334 connected to the manufacturing installation which mentions the characteristic quantity information used as a classification-of-defect result and its foundation later. Moreover, the same information is transmitted to the unit 330 later mentioned for time limits/maintenance check adjustment of test equipment.

[0055] The unit 330 which changes the characteristic quantity information used as a classification-of-defect result and its foundation into the time limits/maintenance check of test equipment hereafter, and the unit 331,332,333,334 which changes sympathy news into the control parameter of a manufacturing installation are explained.

[0056] When there are many misreports, it adjusts a processing parameter and it is made to fulfill the level of equipment for a misreport with the inspection parameter adjustment unit 330, as shown in drawing 11 although there is no defective overlooking of an inspection unit. If the trouble on a device is the cause, it will direct to an operator with a terminal 311. If the focus of the image pick-up section of a detecting element is defective overlooking of a reason while the inspection parameter adjustment unit 330 adjusts a time limits/maintenance check threshold when there is defective overlooking, the inspection parameter adjustment unit 330 will adjust the parameter of a focus. Moreover, if lighting is the cause, the inspection parameter adjustment unit 330 adjusts the amount of illumination light.

[0057] In the case of the defect resulting from membrane formation equipment 321, it changes into a parameter which is related with control of a manufacturing installation as shows the characteristic quantity information used as a classification-of-defect result and its foundation to drawing 12 in a unit 331, and it carries out adjustment control of the membrane formation equipment 321.

[0058] In the case of the defect resulting from an aligner 322, it changes into a parameter which is related with control of a manufacturing installation as shows the characteristic quantity information used as a classification-of-defect result and its foundation to drawing 13 in a unit 332, and it carries out adjustment control of the aligner 322. Here, when a structural trouble is a factor, parameter adjustment is not performed, but an operator is told about being the trouble of a device at a terminal 311, and restoration is urged. If a mask is faulty, while directing exchange of a mask to an operator at a terminal 311 and directing the treatment approach for the foreign matter and blemish which are the cause to an operator, when there are a sink and its foreign matter also in a production control system 335 and a cause is in the whole process about the information, clean-ization of the whole production line is made to direct from a control production control system.

[0059] In the case of the defect resulting from a developer 323, it changes into a parameter which is related with control of a manufacturing installation as shows the characteristic quantity information used as a classification-of-defect result and its foundation to drawing 14 in a unit 331, and it carries out adjustment control of the developer 323.

[0060] When a cause is in an etching system 324 like drawing 15 , if it becomes when it is wet etching, the device parameter adjustment unit 334 will adjust the concentration of a water solution for the concentration of a water solution. Moreover, in the case of dry etching like drawing 16 , the capacity control sections 3341, 3342, and 3343 adjust capacity through the device parameter adjustment unit 334. Moreover, as shown in drawing 17 , unlike the foreign matter distribution at the time of a stationary, the foreign matter which an etching system produces owing to is concentrated only on the range of a certain magnitude, and it can specify that an etching system is the cause easily, the command of washing in equipment by pure water is emitted from the device parameter adjustment unit 334, and self-cleaning of equipment can be performed by automatic vacuum suction after that. These judgments can also be judged not from distribution of the number of foreign matters but from location distribution of the

configuration of a foreign matter and a foreign matter.

[0061] A CVD system like drawing 18 controls delivery, capacity, and a pressure for information from a device parameter adjustment unit to the Gascon troller or a pressure governor.

[0062] Naturally condition **** of a maintenance or equipment of the defect of various manufacturing installations, such as not only the above-mentioned equipment but an annealer, ion implantation equipment, vacuum evaporationo equipment, electric test equipment, etc., or test equipment etc. becomes possible from a classification-of-defect result or the extract information under classification by these approaches.

[0063] As mentioned above, although the unit 330 which changes the characteristic quantity information used as a classification-of-defect result and its foundation into the time limits/maintenance check of test equipment, and the unit 331,332,333,334 which changes sympathy news into the control parameter of a manufacturing installation were explained The characteristic quantity information used as the classification-of-defect result sent to these, and its foundation The defective class memorized by the storage means 352 and its characteristic quantity model parameter are sufficient. In this case, since the statistical information that a stable precision influenced by not each defective data is high can be sent to units 330 and 331,332,333,334, it becomes maintainable [the manufacture process stabilized further].

[0064] moreover, the unit shown in 399 of drawing 2 -- every wafer -- or, if the information which became the radical of the inspection result or an inspection result for every chip is stamped on the location without a circuit pattern by laser etc. If investigation of defective generating between both inspection processes is not only attained, but information is stamped for every chip when it inspects by the next inspection process, investigation of the correlation of the defect of electric inspection results, such as back fail bit inspection by which dicing was carried out, and a process reason etc. will be attained.

[0065] The case where the equipment which inspects the foreign matter which adhered on the semiconductor wafer using the technique currently indicated by JP,54-101390,A as 2nd concrete example is made into an automatic test equipment is described. Drawing 19 is drawing showing the detection principle by the indication technique. 500 is a semiconductor wafer which is an inspected object. 501 is a laser light source and incidence of the laser beam to which S polarization shown by 502 was able to be applied is carried out from this at the horizontally near include angle to the front face of a semiconductor wafer. A detector 503 detects the reflected light to the vertical upper part of this incident light. At this time, the scattered light mainly has many S polarization components from a wafer pattern, and many P polarization components are contained in the scattered light from the foreign matter on a wafer to the thing with few P polarization components. 504 shows a condenser lens and is serving to make a detector 503 condense the reflected light to the vertical upper part. 506 which 505 shown with the broken line shows the scattered light from a wafer pattern, and is shown as the continuous line shows the scattered light from the foreign matter on a wafer. Most scattered lights from a wafer pattern are intercepted with the polarizing plate 507 aiming at S polarization cutoff, and the scattered light which passed along the condenser lens 504 can detect only the scattered light from the foreign matter on a wafer with a sufficient precision in a detector 503. 508 is a processing circuit which outputs the location on that wafer outside, when the luminance signal detected with this detector 503 is processed and the foreign matter on a wafer is detected.

[0066] Drawing 20 is the graph with which the distribution condition of the detection intensity level obtained as a result of making it adhere on a wafer by having used the 1-micrometer standard particle as the foreign matter by the above-mentioned inspection approach and inspecting the wafer whole surface was expressed typically. 510 is the cluster of a wafer pattern and 511 is the cluster of a 1-micrometer standard particle. Although the detection brightness of the scattered light from a wafer pattern is low, since its rate of the surface area occupied to the whole wafer is larger than a foreign matter, a high peak is shown in a low intensity level. Although the rate of surface area of occupying the 1-micrometer standard particle assumed to be a foreign matter on the other hand to the whole wafer is small, since it is detected by high brightness, in a high intensity level, it serves as a low peak and appears.

[0067] Drawing 21 is the case where it is made to adhere on a wafer, having used the 2-micrometer

standard particle as the foreign matter. Since a diffusing-surface product becomes large compared with a 1-micrometer standard particle, it is detected so much by high brightness. Then, if the fixed threshold TH is set up to a detection intensity level as shown in drawing 20 and drawing 21 to detect the foreign matter of a certain magnitude more than fixed, a foreign matter 2 micrometers or more is detectable in this case. Therefore, what is necessary is just to adjust this threshold TH according to the magnitude of a foreign matter to manage in a process. This TH is the sensibility control parameter of foreign matter detection equipment.

[0068] On the other hand, sensitivity control can be attained also by controlling a detection system. That is, if the exposure reinforcement of laser is adjusted by controlling a current in the driver which controls a laser light source, a detection intensity level will change relatively. This situation is explained using drawing 22 and drawing 23 . Drawing 22 is the graph with which the distribution condition of the detection intensity level obtained as a result of making it adhere on a wafer by having used as the foreign matter the 1-micrometer standard particle when setting to I0 the current in the driver which is the same inspection approach, however controls a laser light source and inspecting the wafer whole surface was typically expressed like drawing 20 . Drawing 23 is the graph with which the distribution condition of the detection intensity level obtained as a result of making it adhere on a wafer by having used as the foreign matter the standard particle which is 1 micrometer when setting up the current I1 in the driver which controls a laser light source so that the exposure reinforcement of the one half of the laser radiation reinforcement obtained when referred to as I0 may be obtained and inspecting the wafer whole surface was expressed typically. When a current value I is set to I1 from I0 in the driver which controls a laser light source, since laser radiation reinforcement is halved, the central value 514 and 518 of the clusters 513 and 517 of the wafer pattern shown in drawing 22 and drawing 23 and the central value 516 and 520 of the clusters 515 and 519 of a 1-micrometer standard particle also reduce a detection intensity level by half in proportion to it. Therefore, detection sensitivity is controllable by controlling the current in the driver which controls a laser light source as it can detect when the current value in the driver which controls a laser light source also to the foreign matter of the same size is I0, and it will not be detected when it is I1 if the fixed threshold TH shown in drawing 22 and drawing 23 is formed. Moreover, the same thing can realize the same thing, even if it performs gain control of a detector.

[0069] Based on the position coordinate on the wafer of the foreign matter which the above-mentioned foreign matter test equipment outputs, the image of the semiconductor wafer which is an inspected object is captured in the classification-of-defect equipment shown by 2 of drawing 1 . Since many parts which in the case of a semiconductor wafer are the same chip or the same pattern and do not include a defect are in other locations Institute of Electronics, Information and Communication Engineers paper magazine D-II Vol.J72-D-II No.12 By technique which is indicated by pp.2041-2050 Difference is taken by using the image of a normal part as a reference image, a wafer pattern is removed, a foreign matter part is extracted on an image, and if the area is measured, the magnitude of a foreign matter can be checked. If this processing is performed to the output from the foreign matter test equipment for one wafer, by classifying the magnitude of a foreign matter shows that distribution. It inputs from the input means with which the worker showed the magnitude of a foreign matter to supervise by the result to 6 of drawing 1 connected to classification-of-defect equipment. What is necessary is just to prepare in the unit 3 which showed the computing element which constitutes a processor which realizes the function F Z=F (S) Becoming by drawing 1 , when it considers as the area value S conversion output value Z so that it may be changed into the threshold TH which showed the inputted area value to drawing 20 and drawing 21 or a laser beam exposure on-the-strength control current value, and the gain control value of a detector. How to constitute the drawing 1 unit 3 from a look-up table so that the output value Z corresponding to the area value S can be acquired as an another side type is also considered. However, Z expresses the threshold TH shown in drawing 20 and drawing 21 or the laser beam exposure on-the-strength control current value, and the gain control value of a detector.

[0070] Moreover, if a function which was stated in the example of defective inspection of the wafer pattern mentioned previously is given to the unit 2 shown in drawing 1 , it is possible to bring about the same effectiveness to a manufacture process using the information which can be extracted about a

foreign matter.

[0071] Next, the concrete example applied to the thin film transistor substrate production process for liquid crystal displays is shown. The outline of the flow of the production process of a thin film transistor substrate is shown in drawing 24 . Although it is fundamentally the same as that of the production process of a semi-conductor, weight is set to a circuit tester with an inspection more nearly electric than a poor appearance, and when there are inspection of a short circuit defect and a defect to product total, correction is made as latest operation. The mimetic diagram of electric wiring of a thin film transistor substrate is shown in drawing 25 . As for a thin film transistor substrate, the gate lines (henceforth, G string) 411-415 and drain wires (henceforth, D line) 421-425 must be constituted in the shape of a matrix, and each intersection must be insulated. The thin film transistor 407 and the transparence pixel electrode 408 are constituted by each intersection. Wiring of each [D line / a G string or] is connected by highways 401-403 to substrate completion for the purpose of electrostatic-discharge prevention. Here, it is the short circuit of a G string and a D line, and it becomes the cause of a linear poor display and the short circuit defect 404 is fatal as a product. Therefore, laser cuts the detected short circuit defect 404 electrically. Moreover, a short circuit defect may straddle not only between a G string and D lines but a D line, and a D line, and laser cuts it electrically similarly.

[0072] The configuration of shunt evaluation correction equipment performed to a classification of defect is shown in drawing 26 . It equips with the thin film transistor substrate 400 on the X stage 443 equipped with the positioning sensors 444 and 445, the Y stage 442 and Z stage 441, and the theta stage 440, and probers 447 and 448 are applied to the combination of the highways 401 and 402 of drawing 25 , highways 401 and 403, or highways 402 and 403. Electrical-potential-difference impression is controlled supervising an ammeter 446 by the armature-voltage control section 451. Radiation infrared radiation is incorporated for the febrile state of the current which flows in the short circuit section 404 by carrying out electrical-potential-difference impression as image information with an infrared detector 430. An infrared detector 430 can be equipped with lenses 432, 433, and 434, and can switch them by the revolver 435. The incorporated image information is stored in an image memory 452, and the location of the short circuit defect 404 is pinpointed by processing. It moves based on this detected positional information on a stage 443, and observation of a defective part and electric isolation of a short circuit defect can be performed by the laser [a microscope-cum-] exposure unit constituted from a detector 431, a half mirror 438, a lens 436, and a laser oscillation machine 437. Characteristic quantity is extracted from the image information incorporated with the image information and the infrared detector 430 which were incorporated with the detector 431, it collates with the classification model 456, and a defective class is specified from similarity. This process can apply the approach explained by the above-mentioned wafer inspection by drawing 4 and drawing 9 , and the same technique. In the thin film transistor substrate inspection for liquid crystal displays, unlike inspection which observes an appearance, visually, an unobservable short circuit defect can also be observed with an infrared image in many cases, and this invention can be applied also to the inspection using wavelength with the another usual optical system. After specifying a defective class, while sending information to a cause judging unit like the example of application to a semiconductor wafer and sending information to a production control system, a device parameter adjustment unit, and a detection parameter adjustment unit further, image data 455 and the are recording data of the classification model 456 are updated. It can let an inspection parameter adjustment unit pass from a cause judging unit, and a parameter change of modification of the detection wavelength of shunt evaluation correction equipment etc. can also be made.

[0073] The correction procedure in shunt evaluation correction equipment is shown in drawing 27 . The product which uses as a defective the product which judges by collate the fatality of a defect , and good and the failure of correction of a defect with the classification model 456 , and cannot correct , and can correct from the defective location from the infrared image information extracted from shunt evaluation correction equipment , visible image information , and the amount of leakage current , magnitude , a configuration , calorific value , and short resistance controls a laser radiation location , laser slit length , laser reinforcement , etc. by the device parameter adjustment unit , and corrects automatically .

[0074] Registration of a new model and updating are possible for the classification model 456 of correction used good and improper, and like the case of semiconductor wafer inspection, with a terminal, by an example operator giving an operator the check for a classification-of-defect result at the time of a corrective action, if a classification result is right, a corrective action will be performed, when a classification result is an error, it inputs right defective classification from a terminal, and it performs a corrective action. Moreover, this fix information text is fed back to the classification model 456, and the classification model 456 is updated.

[0075] It is [this invention / other than the above example of application] possible also in application at manufacture and inspection / correction processes of other products, such as Braun-tube manufacture of manufacture of mounting to the substrate of soldering and its inspection correction process, and electronic parts and an inspection correction process, and a thick-film thin film hybrid substrate and an inspection correction process, a CDT display, etc. and an inspection adjustment process, and an electric circuit tester inspection process of a semi-conductor.

[0076]

[Effect of the Invention] According to this invention (A) Since the time limits/maintenance check of an automatic test equipment can be adjusted to the basis of a worker's monitor through the unit 3 of drawing 1 through the unit 6 automatically connected to the unit 2 of drawing 1 by the unit 2 of drawing 1 semi-automatically, the time limits/maintenance check of an automatic test equipment can be adjusted to the time limits/maintenance check which suited the conditions of a manufacture process, without stopping an automatic test equipment.

[0077] (B) Since the time limits/maintenance check of an automatic test equipment can be adjusted to the basis of a worker's monitor through the unit 3 of drawing 1 through the unit 6 automatically connected to the unit 2 of drawing 1 by the unit 2 of drawing 1 semi-automatically, the inspection dependability of an automatic test equipment can be improved for a short period of time.

[0078] (C) According to the effectiveness of (A), when inspecting a new inspected object by the automatic test equipment, compaction of the makeup time of an automatic test equipment can be aimed at.

[0079] (D) Since the adjustment time amount of an automatic test equipment is shortened according to the effectiveness of (A), reduction of the inspected object which passes an inspection process by the mistaken time limits/maintenance check can be aimed at.

[0080] (E) When the classification of a defect is performed by the unit 2 of drawing 1 , it becomes possible to presume the manufacture machine which the property of a defect is known and causes [of a defect] generating from this, and the early stability of a manufacture process becomes possible by adjusting to the description of a defect in view of said manufacture machine through the unit 4 of drawing 1 .

[0081] (F) It can prevent the directions to a correction process becoming exact according to the effectiveness of (B), and performing the mistaken correction to an inspected object.

[0082] (G) As a result, adjustment of the time limits/maintenance check of an automatic test equipment is attained through the unit 3 of drawing 1 by adjusting the unit 2 of drawing 1 with the classification-of-defect result judging input means 10 by the worker connected to the correction unit 11 of drawing 1 , performing defective correction.

[0083] (H) The grasp by the operator of the correlation of a defective generating cause and a manufacture process becomes easy with a means 6 to process and display the information inputted into the information storage means 7 of drawing 1 .

[0084] (I) Situation management of the whole manufacture process is attained by passing the production control system which showed the information inputted into the information storage means 7 of drawing 1 to 15 of drawing 1 .

(J) When there is a unit which shows the same inclination by measuring the classification-of-defect result of the unit 2 of drawing 1 connected to each test equipment and its characteristic quantity in the automatic test equipment installed in every place of a production process, Since it concludes that the monitor of the manufacture process between the automatic test equipments to which the unit was

connected is unnecessary, one of the automatic test equipments of the upstream of a production process or a lower stream of a river can be excluded, and, thereby, the optimal installation point in the manufacture process of test equipment can be defined.

[0085] (K) Since the function which gives the information which serves as an inspection result of an inspected object and its basis by the unit 14 of drawing 1 to an inspected object is offered, it can grasp what kind of causal relation is in the defect detected in that the defect originates in which production process, or a culmination, and the defect detected by the midcourse phase by collating with the result of the inspection after degree process, or a final inspection.

[0086] There is effectiveness to say.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram for explaining this invention notionally.
[Drawing 2] This invention is applied to a semi-conductor production process, and it is a process block diagram at the time.
[Drawing 3] A classification of defect and a characteristic quantity extract unit block diagram.
[Drawing 4] The block diagram showing the classification-of-defect approach notionally.
[Drawing 5] The example of defective cluster distribution in characteristic quantity space.
[Drawing 6] The example of a terminal display.
[Drawing 7] The example of a terminal display.
[Drawing 8] Defective generating cause judging unit block diagram.
[Drawing 9] Defective generating cause judging procedure conceptual diagram.
[Drawing 10] Cause model conceptual diagram.
[Drawing 11] The conceptual block diagram showing the test equipment adjustment control approach.
[Drawing 12] The conceptual block diagram showing the membrane formation equipment adjustment control approach.
[Drawing 13] The conceptual block diagram showing the aligner adjustment control approach.
[Drawing 14] The conceptual block diagram showing the developer adjustment control approach.
[Drawing 15] The conceptual block diagram showing the etching system adjustment control approach.
[Drawing 16] The conceptual diagram showing the dry etching system adjustment control approach.
[Drawing 17] The etching system adjustment control approach at the time of etching system trouble.
[Drawing 18] The conceptual diagram showing the CVD system adjustment control approach.
[Drawing 19] Drawing showing the detection principle of wafer dust particle inspection.
[Drawing 20] The example of detection data of the wafer to which 1-micrometer standard particle was made to adhere.
[Drawing 21] The example of detection data of the wafer to which 2-micrometer standard particle was made to adhere.
[Drawing 22] The example of detection data of the wafer to which 1-micrometer standard particle was made to adhere.
[Drawing 23] drawing 22 -- the same -- however, laser radiation reinforcement -- one half of cases.
[Drawing 24] The flow chart of the production process of a thin film transistor substrate.
[Drawing 25] The mimetic diagram of the electric plugging chart of a thin film transistor substrate.
[Drawing 26] The shunt evaluation correction equipment configuration Fig. which added the defective sort function.
[Drawing 27] The correction procedure in shunt evaluation correction equipment.
[Description of Notations]
1 -- An automatic test equipment, 2 -- Classification-of-defect equipment, 3 -- Defective characteristic quantity -> time limits/maintenance check conversion unit, 4 -- defective characteristic quantity -> a manufacturing installation controlled-variable conversion unit, 5 -- Production control system, 6 [--

Sorting unit,] -- An information I/O means, 7 -- An information storage means, 8 -- A manufacture machine, 9 10 classification-of-defect defective judging information input means, 11 [-- An inspection information stamp unit, 300 / -- A classification of defect and a characteristic quantity extract unit 300a / -- A classification-of-defect unit, 300b / -- Defective generating cause judging unit] -- A defective correction unit, 12 -- A production line, 13 -- Correction Rhine, 14
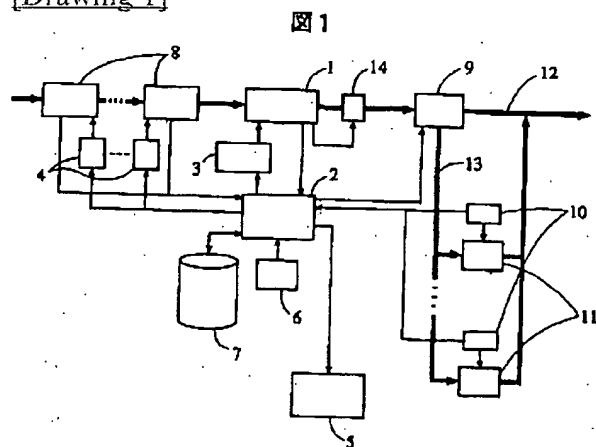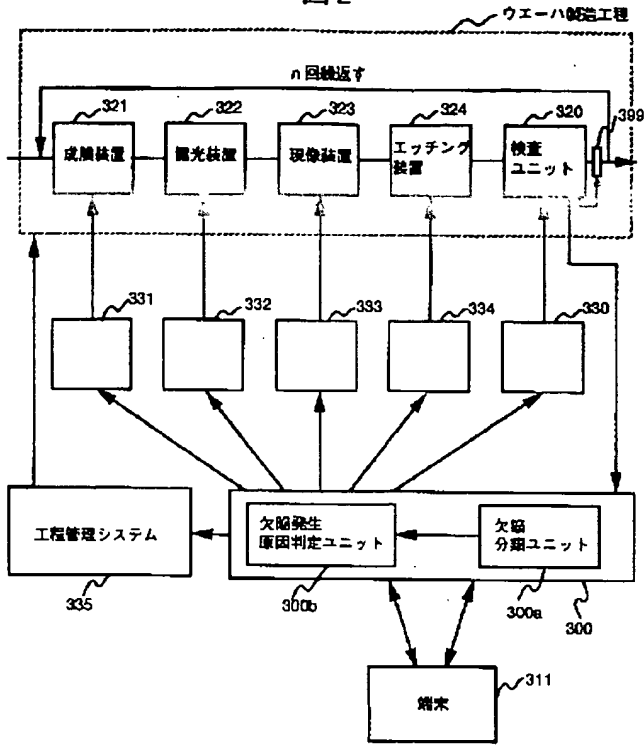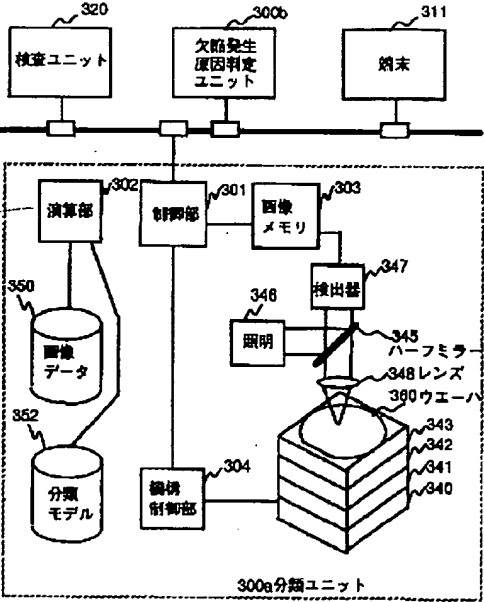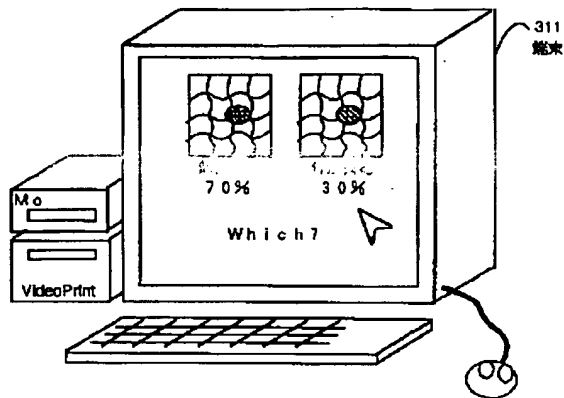
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DRAWINGS

[Drawing 1]

図 1

[Drawing 2]

図2

ウエーハ製造工程

n回繰返す

| 成膜装置 321 | 露光装置 322 | 現像装置 323 | エッチング装置 324 | 検査ユニット 320 | 399 |

331 332 333 334 330

| 工程管理システム | 欠陥発生原因判定ユニット | 欠陥分類ユニット |

335 300b 300a 300

端末 311

330 検査パラメータ調整ユニット
331-334 装置パラメータ調整ユニット

[Drawing 3]

図3

| 検査ユニット 320 | 欠陥発生原因判定ユニット 300b | 端末 311 |

演算部 302　制御部 301　画像メモリ 303

検出器 347

照明 346　345 ハーフミラー

348 レンズ

350 画像データ

352 分類モデル

304 機構制御部

360 ウエーハ

343 342 341 340

300a 分類ユニット

340 Xステージ、341 Yステージ
342 θステージ、343 Zステージ

[Drawing 6]

図 6

[Drawing 4]

図 4

[Drawing 5]

図5

分類空間

特徴量B（縦軸）／特徴量A（横軸）

[Drawing 7]

図7

311 端末
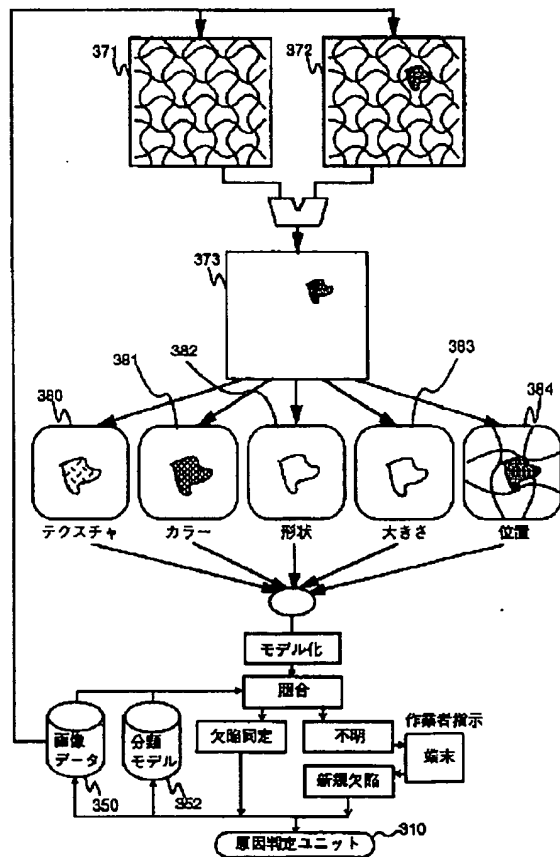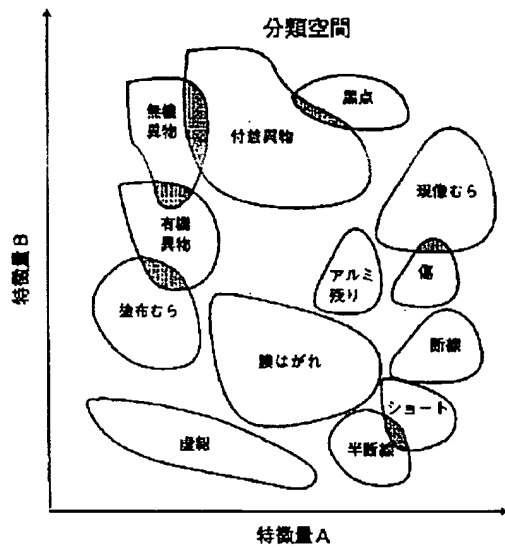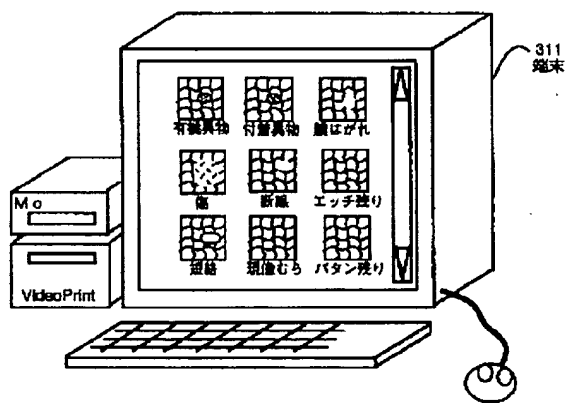
[Drawing 8]

図8
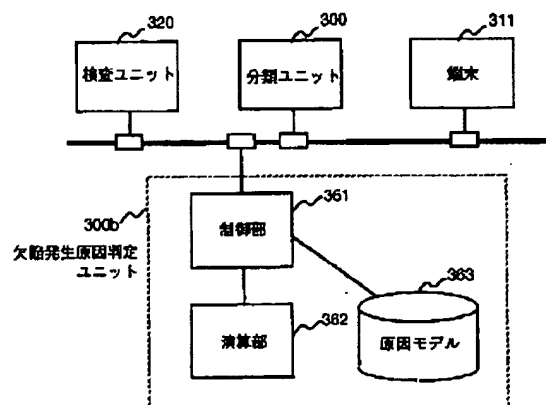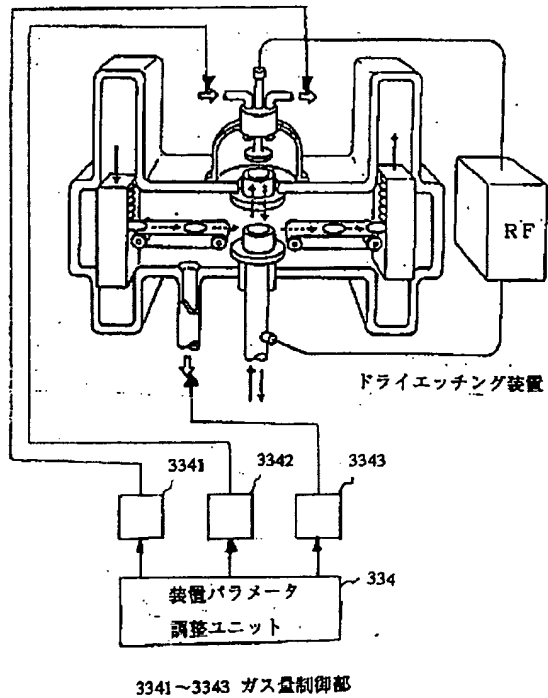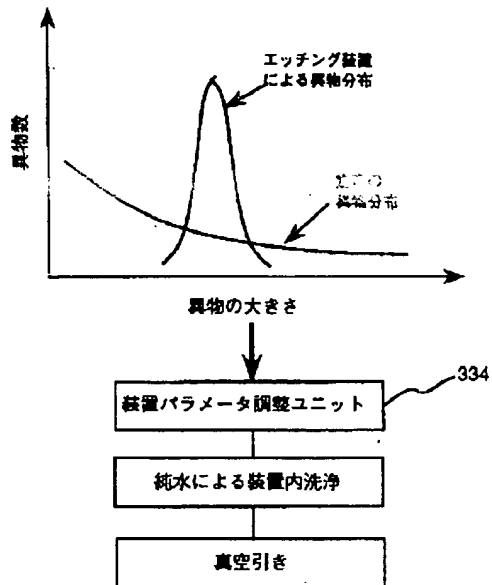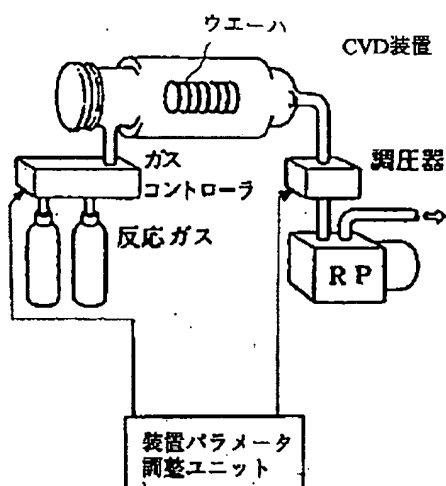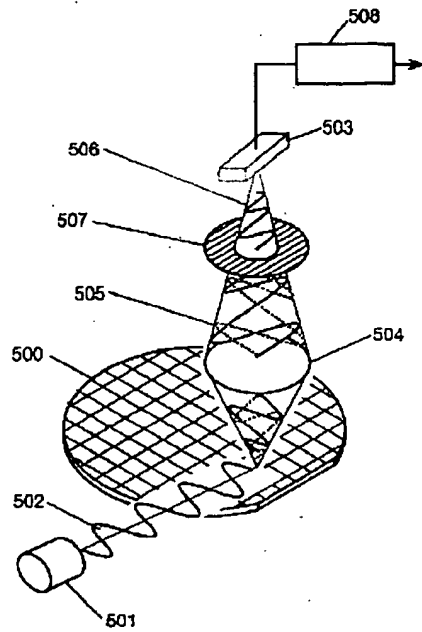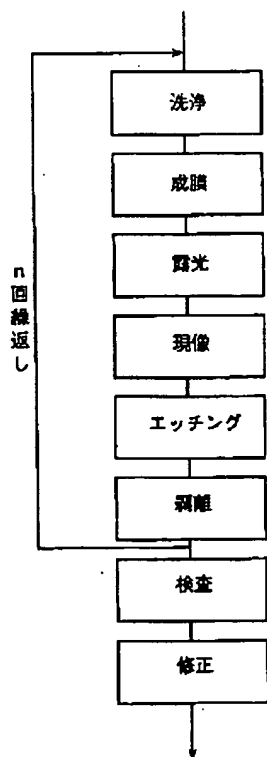

[Drawing 9]

図9
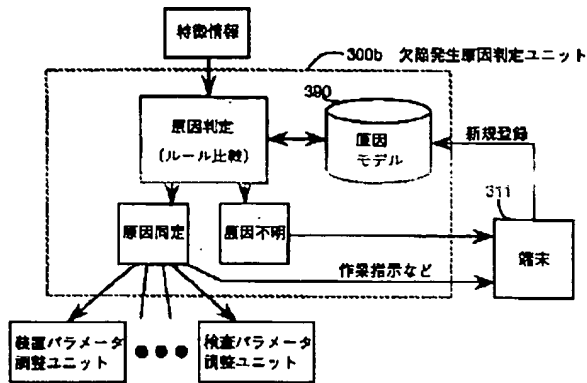
[Drawing 10]

図10
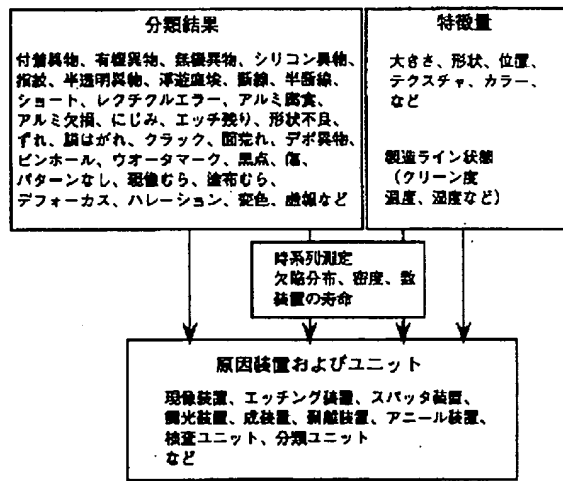
[Drawing 11]
図11

[Drawing 12]

図12

300 欠陥分類・特徴量抽出ユニット

検査結果・特徴量

331
異物
異物起因
プラズマ濃度
熱量
真空度
結晶粒径インゴット材料の品種
電子ビーム
など

321

[Drawing 13]

図13

300 欠陥分類・特徴量抽出ユニット

検査結果・特徴量

332
異物
異物起因
位置ずれ
オートフォーカス
マスク不良
光量
光源ちらつき
レジスト塗布
プリベーク
など

322

[Drawing 14]

図14

300 欠陥分類・特徴量抽出ユニット

検査結果・特徴量

333
異物
異物起因
現像液
ポストベーク
現像時間
温度
など

323

[Drawing 15]

図15

300 — 欠陥分類・特徴量抽出ユニット

検査結果・特徴量

異物
異物起因
水溶液
処理時間
真空度
ガス
など

339 —

324 —

[Drawing 20]

図20

サンプリング数

510

511

TH   検出輝度レベル

[Drawing 16]

図16

RF

ドライエッチング装置

3341   3342   3343

装置パラメータ
調整ユニット   ～ 334

3341～3343 ガス量制御部

[Drawing 17]

図17

エッチング装置
による異物分布

その
異物分布

異物の大きさ

装置パラメータ調整ユニット ∼334

純水による装置内洗浄

真空引き

[Drawing 18]

図18

ウエーハ
CVD装置

ガス
コントローラ
調圧器

反応ガス
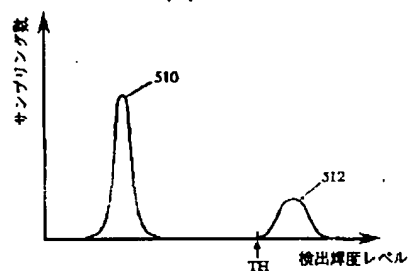
RP

装置パラメータ
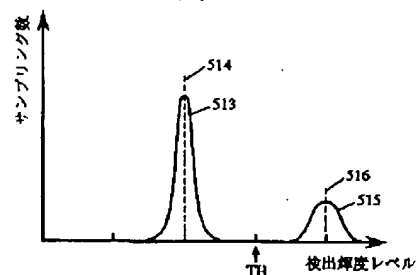調整ユニット

[Drawing 19]

図19

[Drawing 24]

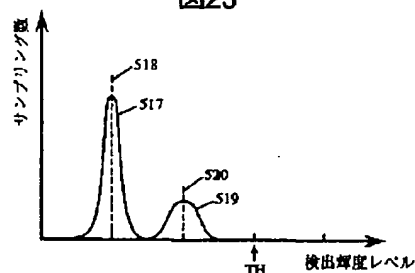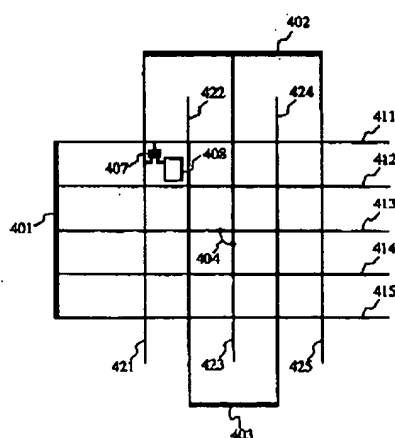図24

[Drawing 21]

図21

図22

[Drawing 22]

図22

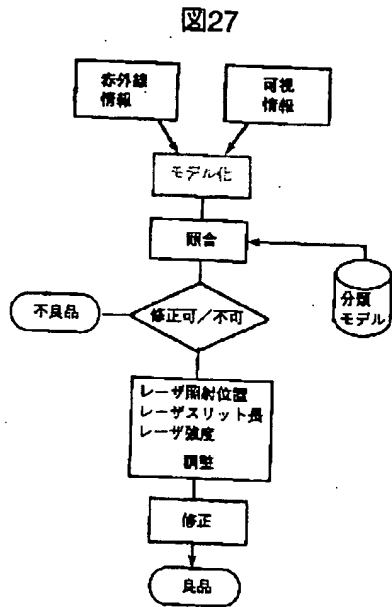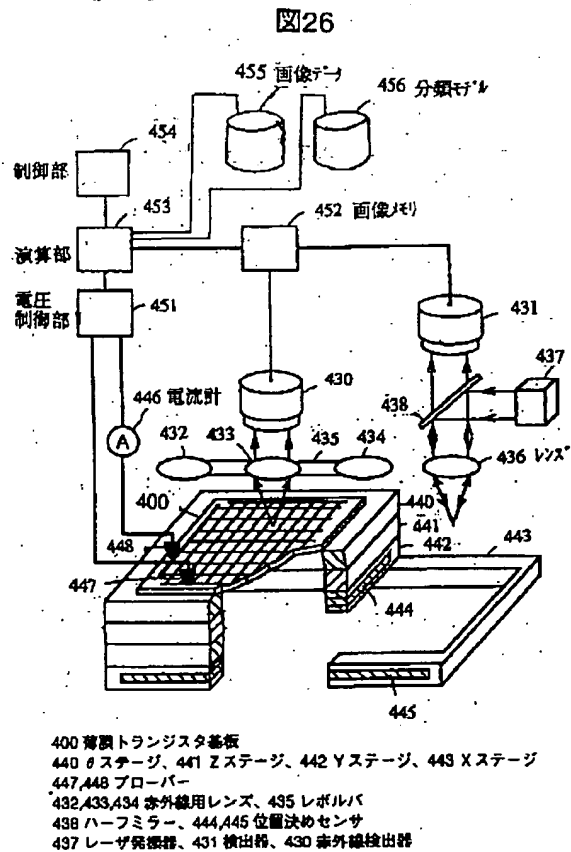[Drawing 23]

図23

[Drawing 25]

図25

401 G共通線、402 De共通線、403 Do共通線
421～425 D線、411～415 G線
407 薄膜トランジスタ、408 透明画素電極
404 短絡欠陥

[Drawing 27]

図27

赤外線
情報

可視
情報

モデル化

照合

分類
モデル

不良品

修正可／不可

レーザ照射位置
レーザスリット長
レーザ強度

調整

修正

良品

[Drawing 26]

図26

455 画像データ　　456 分類モデル

制御部　454

453

452 画像メモリ

演算部

電圧
制御部　451

446 電流計

430

431

437

438

436 レンズ

A

432　433　435　434

400

440
441
442　443

448

447

444

445

400 薄膜トランジスタ基板
440 θステージ、441 Ζステージ、442 Υステージ、443 Χステージ
447,448 プローバー
432,433,434 赤外線用レンズ、435 レボルバ
438 ハーフミラー、444,445 位置決めセンサ
437 レーザ発振器、431 検出器、430 赤外線検出器

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The inspection approach characterized by extracting the defect of an inspected object, classifying the class of defect based on the similarity of a defect based on the information about the this extracted defect, extracting the characteristic quantity about a defect based on the this classified result, feeding back the characteristic quantity about the this extracted defect, and inspecting said inspected object.

[Claim 2] An inspection means to extract the defect of an inspected object, and a class classification means to classify the class of defect based on the similarity of a defect based on the information about the defect extracted with this inspection means, Test equipment characterized by constituting so that it may have a characteristic quantity extract means to extract the characteristic quantity about a defect based on the result classified according to this class classification means, the characteristic quantity about the defect extracted with this characteristic quantity extract means may be fed back to said inspection means and said inspected object may be inspected.

[Claim 3] The automatic check unit 1 which extracts a defect based on the time limits/maintenance check of the inspected object set up beforehand, The unit 2 which is based on the similarity of reception and said defect in the information about the defect according to which it may be extracted in said inspection unit 1, classifies and outputs the class of defect, and extracts the characteristic quantity about said defect based on said classified result, Test equipment characterized by consisting of units 3 which change said characteristic quantity into the time limits/maintenance check of the inspection unit 1, feed back the time limits/maintenance check after conversion to the automatic check unit 1, and adjust the automatic check unit 1.

[Claim 4] It is test equipment according to claim 3 characterized by having a means by which a right classification-of-defect result can be taught when the classification result of the defect performed by said unit 2 is different in said unit 2.

[Claim 5] Test equipment according to claim 3 characterized by having the means which makes it possible to show an operator visually the result that it was similar by the defect, in said unit 2, and for an operator to be able to check each information on a classification-of-defect result and the information relevant to it, and to add new information for said information to modification or said information.

[Claim 6] Test equipment according to claim 5 characterized by having a means to accumulate said information and the information on the defective part of the inspected object corresponding to it for every defect.

[Claim 7] Test equipment according to claim 5 characterized by constituting so that it may have the function to extract the characteristic quantity about a defect and said characteristic quantity may be sent to said unit 3 from the information on the defective part of the inspected object corresponding to two or more information and it which were accumulated in said information storage means.

[Claim 8] Test equipment according to claim 3 characterized by having the means which makes it possible to show an operator visually the result that it was similar by the defect, in said unit 2, and for an operator to be able to check each information on a classification-of-defect result and the information

relevant to it, and to add new information for said information to modification or said information.

[Claim 9] The manufacture approaches, such as a semiconductor device characterized by extracting the defect of a semiconductor device etc., classifying the class of defect based on the similarity of a defect based on the information about the this extracted defect, extracting the characteristic quantity about a defect based on the this classified result, feeding back the characteristic quantity about the this extracted defect to manufacturing installations, such as a semiconductor device, and manufacturing a semiconductor device etc.

[Claim 10] Manufacturing installations, such as a semiconductor device characterized by to feed back the characteristic quantity about the defect extracted from the test equipment which extracts the defect of a semiconductor device etc., classifies the class of defect based on the similarity of a defect based on the information about the this extracted defect, and extracts the characteristic quantity about a defect based on the this classified result, and this test equipment to manufacturing installations, such as a semiconductor device, and to manufacture a semiconductor device etc.

[Claim 11] The automatic check unit 1 which extracts a defect in manufacturing installations, such as a semiconductor device which manufactures a semiconductor device etc., based on the time limits/maintenance check of the semiconductor device set up beforehand about the semiconductor device manufactured by this manufacturing installation, The unit 2 which is based on the similarity of reception and said defect in the information about the defect according to which it may be extracted in said inspection unit 1, classifies and outputs the class of defect, and extracts the characteristic quantity about said defect based on said classified result, Manufacturing installations, such as a semiconductor device characterized by having the control means 4 which changes and feeds back said characteristic quantity to the parameter which controls the condition of manufacturing installations, such as a semiconductor device, and controls said manufacturing installation.

[Claim 12] They are manufacturing installations, such as a semiconductor device according to claim 11 characterized by having a means by which a right classification-of-defect result can be taught when the classification result of the defect performed by said unit 2 is different in said unit 2.

[Claim 13] Manufacturing installations, such as a semiconductor device according to claim 11 characterized by having the means which makes it possible to show an operator visually the result that it was similar by the defect, in said unit 2, and for an operator to be able to check each information on a classification-of-defect result and the information relevant to it, and to add new information for said information to modification or said information.

[Claim 14] Manufacturing installations, such as a semiconductor device according to claim 13 characterized by having a means to accumulate said information and the information on the defective part of the inspected object corresponding to it for every defect.

[Claim 15] Manufacturing installations, such as a semiconductor device according to claim 13 characterized by constituting so that it may have the function to extract the characteristic quantity about a defect and said characteristic quantity may be sent to said unit 3 from the information on the defective part of the inspected object corresponding to two or more information and it which were accumulated in said information storage means.

[Claim 16] Manufacturing installations, such as a semiconductor device according to claim 11 characterized by having the means which makes it possible to show an operator visually the result that it was similar by the defect, in said unit 2, and for an operator to be able to check each information on a classification-of-defect result and the information relevant to it, and to add new information for said information to modification or said information.

[Claim 17] the time when said unit 2 cannot classify the classification result of the defect of an inspected object into the existing category -- this -- a defective class -- the class which it presupposed that it is unknown, and the information and related information of said defective part were shown to the operator, and was shown the operator -- manufacturing installations, such as a semiconductor device according to claim 11 characterized by having a means by which the new or existing classification, a name, etc. can be taught to an unknown defect.

[Claim 18] The information on said defective part is manufacturing installations, such as a

semiconductor device according to claim 11 characterized by being the image information which consists of a detection defect and its near.

[Claim 19] Manufacturing installations, such as a semiconductor device according to claim 11 characterized by making predetermined correction for the inspected object inspected in the automatic check unit 1 in said unit 2 according to the result that it was similar by the defect on a defective correction unit to a sink and said defect.

[Claim 20] They are manufacturing installations, such as a semiconductor device according to claim 19 characterized by having the function which an operator can control activation of a corrective action, can teach a right classification-of-defect result in said defective correction unit in said defective correction unit when the classification result of the defect directed by said unit 2 is different, and can feed back the information to said unit 2.

[Claim 21] The inspection approach according to claim 1 characterized by using the pattern information on a defective detection image as similarity of said defect.

[Claim 22] The inspection approach according to claim 1 characterized by using the signaling information of defective detection information as similarity of said defect.

[Claim 23] The manufacture approaches, such as a semiconductor device characterized by ****** which gives the information relevant to an inspection result, a measurement result, each either, or both, such as a semiconductor device, to said inspected object.

[Claim 24] Manufacturing installations, such as a semiconductor device according to claim 11 characterized by transmitting the characteristic quantity about the defect extracted in said unit 2 by said unit 4 which chooses the manufacturing installation presumed to be the defective generating cause in view of the classification result of a defect, and the attribute of the defect in said unit 2, and is connected to said manufacturing installation.

[Claim 25] The manufacture approaches, such as a semiconductor device according to claim 9 characterized by using the pattern information on a defective detection image as similarity of said defect.

[Claim 26] The manufacture approaches, such as a semiconductor device according to claim 9 characterized by using the signaling information of defective detection information as similarity of said defect.

[Translation done.]